Study on Superior Business Process Segment Extraction Algorithm

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Abstract

The basic of manufacturing cloud service is manufacturing resource, and the business process is the business context of the manufacturing resource. In order to provide advantage manufacturing resources for cloud services, a method to construct advantage hybrid granularity manufacturing resource based on advantage business process is proposed. Based on enterprise business process, business process evaluation criterion and calculation method of its activity performance weight value vector are constructed, and then based on which a method of superior business process segment extraction algorithm is constructed. Experimental results prove that the algorithm for extraction of the competitive hybrid granularity manufacturing resource segment is valid.

Keywords

Hybrid Granularity Manufacturing Resource; Business Process; Superior Business Process Segment Extraction Algorithm

Introduction

With in-depth application of cloud computing in manufacturing industry, there appear various kinds of cloud services on the Internet, in which there are many services with similar functions and different quality of service.All these cloud services are selected to meetfunctional requirements and nonfunctional requirements of users. Therefore, to improve the utilization efficiency of cloud services, service providers need to improve the competitiveness of cloud services. While a cloud service depends on its material basis, namely,manufacturing resource, its strength directly affect the strength of the cloud service based on it.

There have been many researches about construction of manufacturing resources. From the perspective of manufacturing resource function characteristic, WEI Yun et al. (2012) studied the unified manufacturing resource modeling based on element model and service-oriented, the manufacturing resources application services were described into six conceptual elements including the application of business process. Linan Zhu et al. (2013) constructed manufacturing resources model separately from the enterprise end and the cloud manufacturing platform end, with the enterprise end being oriented toward the enterprise interior, constructing two size resources of the single granularity and composite particle. From the perspective of manufacturing resources organization, YAO Changfeng et al. (2008) established the manufacturing resources organization model including physics manufacturing unit layer, work center layer and physical equipment layer. As for the manufacturing resources business process, NIU Ling et al. (2011) pointed out that the manufacturing resource includes both single manufacturing service activities and multi manufacturing service activities. LUO Yongliang et al. (2012) studied key technology of modeling of manufacturing in the environment of cloud manufacturing, constructing multidimensional model of manufacturing capacity, including resource, process, task and knowledge, of which the resources were divided into main and auxiliary bodies of resources, the main resource mainly refers to the main body of manufacturing capacity formation, which is the key of formal description for manufacturing capabilities.

These studies construct resources from different angles, but are related to the business process resources, which has certain positive effects on the construction of mixed size manufacturing resources. But they did not pay enough attention to the dominance of manufacturing resources, only from the function and the quality of service to ensure resources to be selected to use, and can not guarantee to improve resource dominance in the fierce market competition. FANG Ding et al. (2009) studied a method of process oriented business service design, which started from the process analysis, considering the two basic goals

for loose coupling and degeneration of the process. The dependent between processes was quantized through activity dependent relationship, introducing elements of competition to quantify the process' contingency. It was not on the competitive measure.

Considering that the manufacturing resource has its own business environment, which is in the environment of business process, and many resources themselves are not strong, while combining its some context resources can form higher overall performance of process resources, and in order to play the overall ability, and gained a strong overall dominance, this study try to construct hybrid granularity dominance manufacturing resource based on business process, thus to provide new ideas and new ways for the construction of cloud manufacturing service, and also to provide new ideas and new ways for the cloud manufacturing (Wu, Dazhong et al., 2013; TAO, F. et al., 2011; Xi Vincent Wang, Xun W. Xu, 2013).

Construction Of The Advantage Mixed Size Manufacturing Resource

Related Notion

Business process can be expressed as BPL=(actions, flow),of which actions is a collection of business process activities, actions={act1,act2,…,actm}.The flow is the business process logic structure, composed of a series of control operator, mainly including the Sequence, Selection, Parallel, Cycle. The schematic diagram is described in Fig. 1. Advantage business process refers to the business process with competitivity or business fragments from the overall enterprise situation evaluation. A critical activity of the business is with service function significantly to the whole business process performance on the advantage business process.
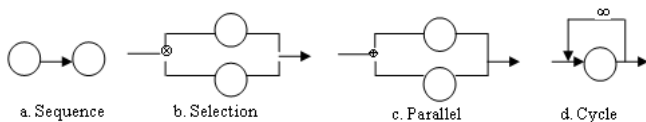

FIG.1 PROCESS CONTROL OPERATORS

The Advantage Manufacturing Resources Construction Process

To find out what are the advantages business at enterprise, then analysis the business process, and determining which business activities are large weight activities at the performance, and then extracting the advantage fragments with large function coupling, further more, determining advantage resources of the

various activities in the various advantage segments, advantage resources of each activity can be discovered by comparing and analyzing resources based on the business process. Some of the resources playing a key role are advantage resource of the activity, while some resources playing a supporting role are auxiliary resource of the activity. This process can be seen from Fig. 2.
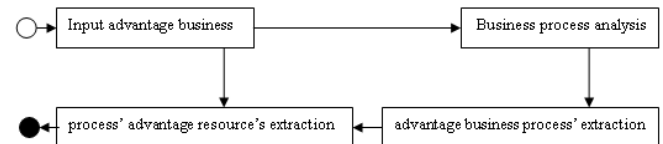

FIG. 2 FLOW TO DETERMINE CORE BUSINESS CTIVITIES

Business Activities' Performance Evaluation

Business activity performance evaluation criteria 1: each activity accounts for credit weight among all activities in the business process, which results in the score the experts evaluate on the various business activities, and the higher the score, the greater the credit is. The score index can be formulated as following: production time, technical content, quality of the product, cost, importance, and the degree of external dependence and so on. Meaning of the indicators are as follows.

Production time refers to the time cost in the whole production process time for finishing the business activities by the business activities. During the product performance, the longer the time is, the smaller the business activity performance is.

The technique content and degree of difficulty are the technical degree activity dependent. With technical content become higher and more difficult,, the campaign will receive higher weights during the product performance.

Effect on the quality of the product is related to the degree of the business activities on the quality of the final product. While the effect degree is higher, the business activity performance is lower.

Cost refers to the cost implemented by the business activity. Generally, the more the cost is, the lower the business activity performance is.

Activity importance refers to its degree of importance in the whole business process fragment. If the business activity is the main activity of the business process fragment, the most close to the core business ability, the importance of the activity is more significant and its performances , on the contrary, will decrease.

The degree of activities' external dependence refers to the sum of both introduction(positive value) and export (negative value) produced in the cooperation process of the business activity and external. The greater the positive value is, the more the introduction value is, which indicates performance of the business activity in the whole business process is weak. On the contrary, it is too large.

Definition3. Business process set vector. $\mathbf{X} = (x_1, x_2..., x_i, ...x_n)$, $i = 1, 2, ..., n$, where x_i expresses the business activity, n expresses the number of activities. $\mathbf{W}^x = (w_1^x, w_2^x, ..., w_j^x, ..., w_n^x)$, $j = 1, 2, ..., n$, where W^x expresses the weight vector of each business activity performance, w_j^x expresses the weight of corresponding x_j. The higher the value, the higher business performance of the corresponding business activity. It satisfies $\sum\limits_{j=`1}^{n} w_j^x = 1$.

Definition 4. Each business activity performance index vector. $\mathbf{Z} = (z_1, z_2, ..., z_i, ..., z_m)$, $i = 1, 2, ..., m$, where z_i expresses the i business performance indicator, reflecting certain aspects of the performance of the activity, and m expresses index number. $\mathbf{W}^z = (w_1^z, w_2^z, ..., w_j^z, ..., w_m^z)$, $i = 1, 2, ..., m$, where W^z expresses business activity index weight vector, and w_j^z expresses weight corresponding to z_j, the higher the value is, the more the business performances are in all the corresponding business activity performance index. It satisfies $\sum\limits_{j=1}^{m} w_j^z = 1$.

Definition 5. The expert score vector. $\mathbf{F}_i^x = (f_{i1}^x, f_{i2}^x, ...f_{ij}^x, ..., f_{im}^x)$, where F_i^x expresses performance evaluation index vector of x_i ($i = 1, 2, ..., n$), and f_{ij}^x expresses the expert scoring average of z_j of x_i ($j = 1, 2, ..., m$), formulas are as following:

$$w_i^x = \frac{\sum\limits_{j=1}^{m} f_{ij}^x \cdot w_j^z}{\sum\limits_{i=1}^{n} \sum\limits_{j=1}^{m} f_{ij}^x \cdot w_j^z} \quad (1)$$

$$w_j^z = \frac{f_{ij}^x}{\sum\limits_{j=1}^{m} f_{ij}^x} \quad (2)$$

Where, score standards of business activities and resources can be assessed at the same level. Therefore, the following uniform standard can be adopted,

namely, fuzzy evaluation method or superiority factor evaluation grade: very strong, strong, relatively strong, nearly, slightly inferior, relatively poor, poor, which can be allocated as rating numerical: 7, 6, 5, 4, 3, 2, 1. The higher the score is , the more strong its advantage is.

Comprehensive performance of each activity in business process can be obtained by formula (1), (2).

Construct Of Advantage Process Fragment

The activity performance weight vector of the business process can be gotten based on the evaluation method of the core business activities. Values of the vector may be:

(1)Weight values around the height peak are larger

(2)One end of the height peak is larger

(3)Height peak is outlier

(4)No peaks but a whole is too large

A key problem of fragment extraction is how to intercept the fragment. Principles for intercept fragment are as following: one is maintaining the integrity of the process logic, two is the coupling, not separating but often binding activity, and three is higher whole performance. Here, calculation method of the overall performance value is done by calculating the average fragment performance.

The overall association extension extraction algorithm (OAEEA) is designed by taking different measures to extract according to the case of the vector value, and accounting for coupling process and the whole performance of the fragment, which extracts advantage fragment in business process.

The algorithm process is as following:

(1) Firstly to calculate business process performance weight vector

(2) Then to select the maximum weight value elements in the process called crest, if close values are too few, they are all selected. If there is no clear peak, there is a period of relatively large and smooth elements, which is extracted as an independent whole.

(3) In view of each maximal element, extract its upper and lower elements. For each extracted element, combined with the process logic of corresponding activity, ①for the parallel nodes; all nodes in the parallel need to be extracted; for the selection structure, select the branch

with large performance value.

nodes, also extract the parallel nodes;extract branch structure with large performance value to maintain the integrity of the process logic. Expanded interception is done through combining with the often bundled activities, if value reaches the ends of slumping (In this study, each wave is seen as the calculating unit, and the average values of the wave is computed), it stops expansion; try to ensure the interception of the elements to achieve a higher performance value. ③For individual elements, refer to the business logic, if it is not complete, then extend to complete, trying to extend the minimum range, if encountered in slumping, it stops.

as single granularity resource.

(4) Save the extracted edge fragment.

Pseudo code for OAEEA algorithm is presented as following according to the above algorithm process.

> Input: Businessx,{KunActiony|y=1,…,n}
> Output: {Procz|z=1,…,m}
> 1. Input: Businessx
> 2. W^x =Calculate(Businessx)
> 3. Bofeng=Select(W^x)
> 4.for(int i=0;i<k;i++)
> 5.   { if(node)
> 6.   {if(Up)
> 7.   {extend to up_boundary
> 8.   get left_proc}
> 9.   }
> 10.   else
> 11.   {extend to down_boundary
> 12.   get right_proc}
> 13.   }

②For the flow dstream

> 14.   else
> 15.   {if(Up)
> 16.   {extend to up_boundary
> 17.   get left_proc}
> 18.   }
> 19.   else
> 20.   {extend to down_boundary
> 21.   get right_proc}
> 22.   }
> 23.   save Procz

Experiment

The following are examples of the solution process for comprehensive performance of business activities.

④The isolated points are extracted.

For example, if the business process is as shown in Fig.3, including three activities x1, x2 and x3, composed according to sequence. Their data are obtained according to the following procedure.
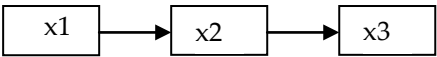

FIG. 3 BUSINESS PROCESS EXAMPLE

Firstly, business analysts establishes a performance index table, then the experts score, finally, average value of each index according to the expert scoring is calculated. The results are shown in Table 1.

w_j^z Of the three activities can be calculated through formula (2), which are x1(0.18,0.21,0.21,0.17,0.13,0.1), x2(0.2,0.17,0.18,0.17,0.17,0.11), x3(0.2,0.2,0.23,0.17,0.13, 0.07) in turn.Finally, w_i^x can be calculated through formula (1), results of which are 0.34, 0.38, 0.28 respectively.

TABLE 1 PROCESS SAMPLE

act	expert	time	technology	Production quality	cost	important	external dependence
	J1	5	5	6	5	3	3
	J2	6	6	5	4	4	3
	J3	4	5	5	6	3	2
x1	J4	5	6	5	4	4	2
	J5	4	5	6	4	3	3
	J1	6	5	6	5	5	4
	J2	6	4	6	6	5	3
	J3	7	5	5	6	5	4
x2	J4	6	6	5	4	4	3
	J5	5	5	6	4	6	3
	J1	4	5	4	3	3	2
	J2	5	4	5	4	3	1
	J3	4	5	5	3	3	2
x3	J4	4	3	5	4	2	2
	J5	4	4	6	4	3	1

Advantage fragment of the example at Fig. 3 is extracted based on the above algorithm. Extraction result is as follow. Its value of peak is 0.38, including the expansion of it. Due to the business process which is a simple sequential structure, the extension is simple. Extended to the left (belongs to type of the high end) for it, and done judgment in accordance with the sharp boundary, the value of the left element is in the boundary line. At the same time, combined with the binding information (If there is, it must be extracted), the left element is included into the extension set. While the right is under the boundary line, so stop to extend. Finally, an advantage fragment of x1x2 is gotten.

Conclusion

From the perspective of the business process of manufacturing resources, advantage business process segment extraction algorithm is constructed. Through experiment, it is verified that the algorithm is valid. The innovations of this paper are evaluation method of the advantages of business process and its extraction algorithm is constructed based on business process.

In the future, the further research on performance evaluation factors' selection and the endeavour on perfecting the evaluation system will be done. Cloud service building study based on it will be done to provide theoretical and practical basis for the development of cloud manufacturing.

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